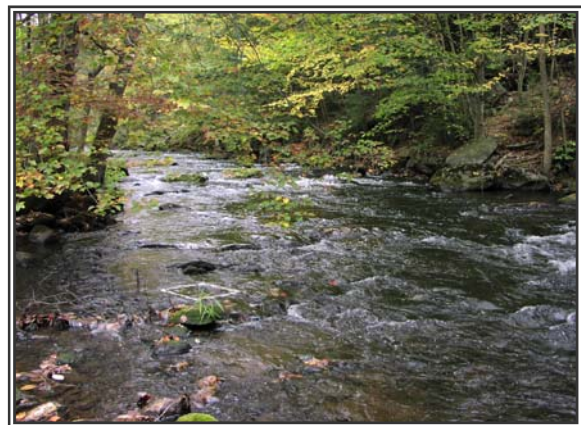


New Hampshire Volunteer River Assessment Program

2001

SUGAR RIVER

Water Quality Report



February 2003

STATE OF NEW HAMPSHIRE
Volunteer River Assessment Program
2001
SUGAR RIVER
Water Quality Report

*STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
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February 2003

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PREFACE

During the summer of 2001, the U.S. Environmental Protection Agency (EPA) and DES initiated a water quality sampling program to support the development of a total maximum daily load (TMDL) for the Ashuelot River. This work focused on dissolved oxygen. Sampling stations were established in Sunapee and continued to Claremont. As noted throughout this document, DES recommends continued monitoring for dissolved oxygen and pH. Regarding dissolved oxygen, continued monitoring will benefit the public and DES by providing data before and after implementation of the TMDL.

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1. ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services-Volunteer River Assessment Program extends sincere thanks to the volunteers of the Sugar River group during 2001. This report was created solely from the data collected by the volunteers. It is their time and dedication that not only contributes to the amount of knowledge of rivers and streams in New Hampshire, but also expresses the genuine concern for local water resources.

2. VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW

The Volunteer River Assessment Program (VRAP) supports watershed organizations in their efforts to monitor river water quality. The primary focus of VRAP is to provide volunteers with river monitoring guidelines, equipment loans, and technical training. DES also incorporates applicable volunteer monitoring results into its evaluation of New Hampshire surface waters. Annual reports for each VRAP river include a summary of monitoring results and recommendations for future water quality sampling. VRAP aims to foster public understanding and stewardship of river systems and to increase available water quality information about New Hampshire rivers and streams.

VRAP loans and maintains water monitoring kits that include meters and supplies for on-station measurement of five basic water quality parameters: water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. The investigation of these and additional parameters such as nutrients, metals, and *E. coli* is conducted by state water quality personnel and may be augmented by volunteer sampling. Sampling additional parameters comes with the cost of analysis, which can be covered by an assortment of fundraising activities such as association membership fees, special events, and in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results meeting DES Quality Assurance and Quality Control (QA/QC) requirements supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

VRAP typically recommends sampling every other week during the summer, and citizen monitoring groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers arrange a sampling schedule and design in cooperation with the VRAP Coordinator. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Each VRAP volunteer must attend an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to come together and receive an updated version of monitoring techniques. Training sessions are typically conducted outdoors near surface waters for an interactive demonstration. During the training volunteers have a chance to practice using the VRAP equipment and may also receive instruction in the collection of samples for laboratory

analysis. Training is accomplished in approximately three hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. VRAP aims to visit volunteers during scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. Volunteer organizations forward water quality results to the VRAP Coordinator for incorporation into an annual report and state water quality assessment activities.

Applicable volunteer data are input to a water quality database, and considered (along with other reliable sources of data) during periodic DES water quality assessments. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act.

More than fifty VRAP volunteers sampled seven rivers regularly during the year 2001. VRAP 2001 rivers include the Sugar, Exeter, Lamprey, Cocheco, Powwow, Ashuelot, and Oyster rivers, as well as preliminary sampling on several additional rivers and streams. These accomplishments were made possible by the hard work and dedication of citizen volunteers and many additional people who helped to plan, support, and carry out these monitoring efforts.

3. PROJECT SUMMARY: SUGAR RIVER VRAP 2001

Water quality monitoring of the Sugar River by the volunteers included in the VRAP began in 2000. This monitoring continued with enthusiasm during 2001. Water samples were collected from sites on the mainstem and tributaries throughout the watershed. The volunteers were not only interested in the core VRAP water quality monitoring parameters, but were also interested in determining the concentrations of arsenic, total phosphorus, mercury, biochemical oxygen demand (BOD), and other parameters.

During 2001, sampling was focused on 9 stations along the river and tributaries, including the towns of Sunapee, Newport, and Claremont. Samples were collected every two weeks during May through September, and approximately monthly from March through April and October through December.

4. RESULTS, DISCUSSION, AND RECOMMENDATIONS

This section includes a description of the Sugar River VRAP 2001 monitoring locations and results, a discussion of the results in comparison with New Hampshire water quality standards, and recommendations for future sampling and watershed investigations. The VRAP monitoring locations, "stations", are discussed from upstream to downstream (Appendix A). Each station is described by a map and by a narrative station description submitted by volunteers. Results are presented in graphs and text prepared by the VRAP,

and tables including all monitoring results from each station are located in Appendix B. The discussion of the results includes recommendations for future sampling and investigations that will contribute to the assessment of water quality conditions.

The water quality information collected at each station is summarized in a table that provides the reader with an overview of the monitoring activities and results. The table can be used as a quick reference for the reader; results not meeting state water quality criteria do not necessarily indicate a violation of water quality standards. The summary table indicates: (1) the number and type of samples collected, (2) the number of samples collected according to quality assurance and quality control requirements, (3) the number of samples not meeting state water quality criteria, (4) the range of the measurements, and (5) abbreviated water quality standards.

The presentation and discussion of the volunteer results focuses primarily on three parameters: DO, temperature, pH, and *E. coli*. These parameters are the core of the VRAP monitoring system, and have relatively straightforward standards that lend themselves to the assessment of individual results. These results can contribute directly to the determination of fishable and swimmable river and stream conditions, which is often a primary volunteer monitoring goal. This section includes graphs of dissolved oxygen (DO) concentrations with water temperature, and *E. coli* bacteria results (if collected). Please see Appendix C for descriptions of the water quality parameters analyzed under VRAP during 2001 and the associated New Hampshire surface water quality standards (SWQS) for Class B waters.

The current report format will describe water quality conditions on a station-by-station basis. The reader should note that discussion is limited to those parameters at each station that do not meet state criteria. For example, since pH is the only parameter at 19-Sgr that exceeded state criteria, only pH will be discussed in detail. However, recommendations are not limited to parameters with results that fall outside state criteria.

VRAP aims to provide a mechanism for citizens to contribute to the ongoing process of surface water quality assessment. Recommendations for future monitoring activities and watershed investigations are included in this report following the results and discussion. Also included are recommendations for improvements in sampling techniques to encourage volunteers to adhere to quality assurance and control measures.

Volunteers are encouraged to sample their rivers and streams on a long-term basis. Much of the information volunteers collect profiles river and stream locations for the first time. Several (five to ten) years of good quality measurements will be needed to begin to decipher water quality trends and the status of rivers and streams relative to the New Hampshire surface water quality standards. Water quality data from the stretch of river sampled by volunteers are presented in graphs in Appendix D. These graphs are included in the report to show how water quality conditions change from upstream to downstream. All results generated by the Sugar River VRAP 2001 were collected using the VRAP Field Datasheet and Field Sampling Protocols, 2001 (see Appendix E).

4.1. 19-Sgr: Route 11 Bridge, Sunapee, NH

4.1.1. Station Description

19-Sgr is located on a main road, a half-mile from its source, Lake Sunapee (Figure 1). The lake is surrounded by numerous summer and year round homes and attracts many recreational boaters. A small gas station is located just upstream of the station. The riverbanks show signs of erosion and the riverbed is made of cobblestones.

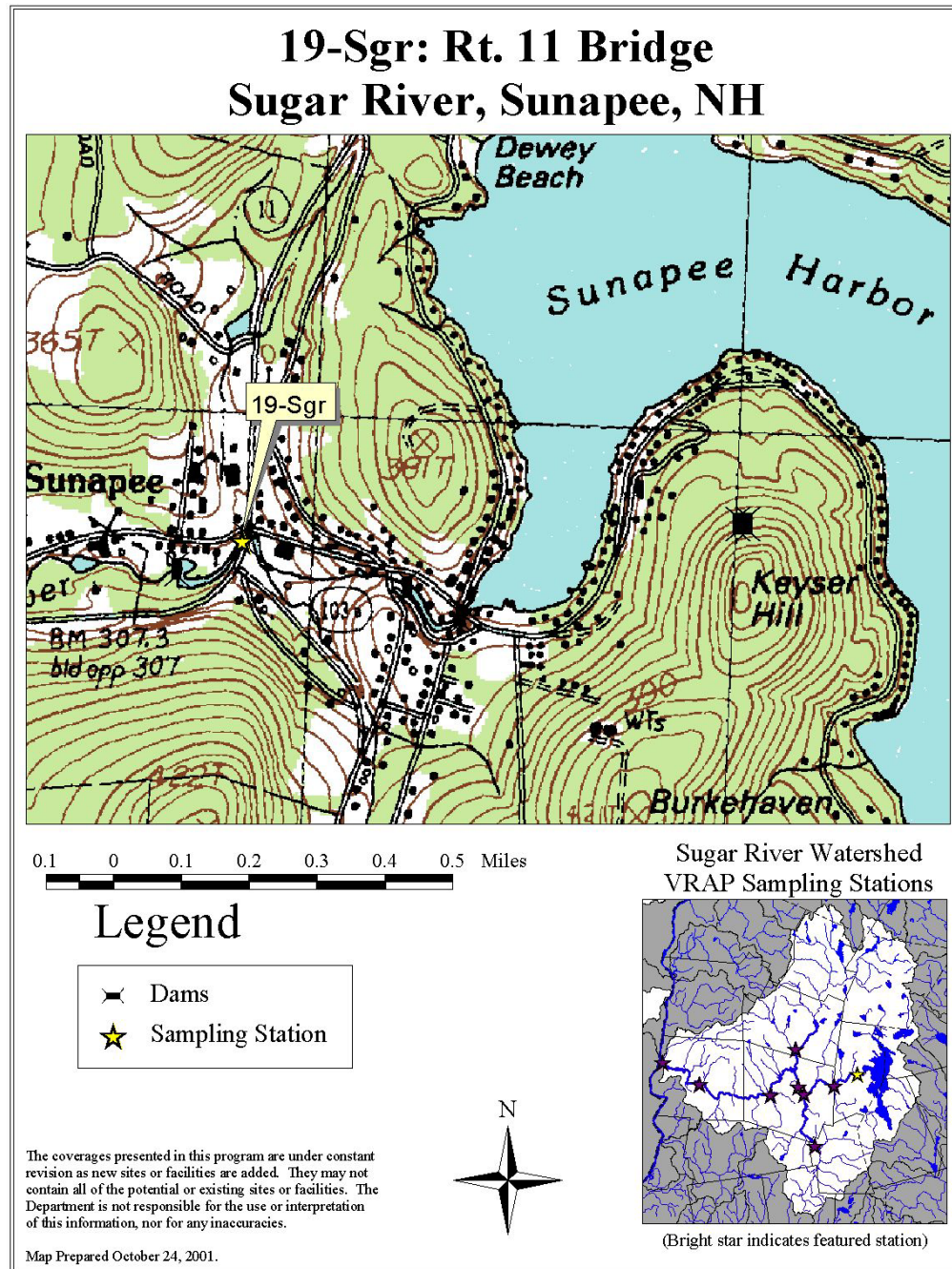


Figure 1. Station location map for 19-Sgr, Sugar River, New Hampshire, VRAP 2001.

4.1.2. Results and Discussion

Fourteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 13 measurements were made for conductivity in the field using handheld meters (Table 1). Seven samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Eleven pH measurements were below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 1. Monitoring Summary: 19-Sgr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	7.9 - 13.67	>5
DO (% sat.)	14	14	0	90.6 - 114	>75
pH (Std. Units)	14	14	11	5.74 - 7.62	6.5-8.0
Turbidity (NTU)	14	14	0	0.05 - 1.69	<10 above background
Conductivity (µmho/cm)	13	13	0	58.2 - 121.2	NA
<i>E. coli</i> (CTS/100mL)	7	7	0	0 - 23	<406
Total Phosphorus (mg/L)	4	4	NA	0.012 - 0.28	NA
NO ₃ (mg/L)	11	11	NA	<0.05 - 0.26	NA
Lead (mg/L)	1	1	0	<0.001	<0.014
Alkalinity (mg/L)	9	9	NA	2.0 - 29.2	NA
BOD ₅ (mg/L)	5	5	NA	6.73 - 8.83	NA
Arsenic (mg/L)	1	1	0	<0.001	<0.34
Mercury (mg/L)	1	1	0	<0.001	<0.0014

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 19-Sgr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 2). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

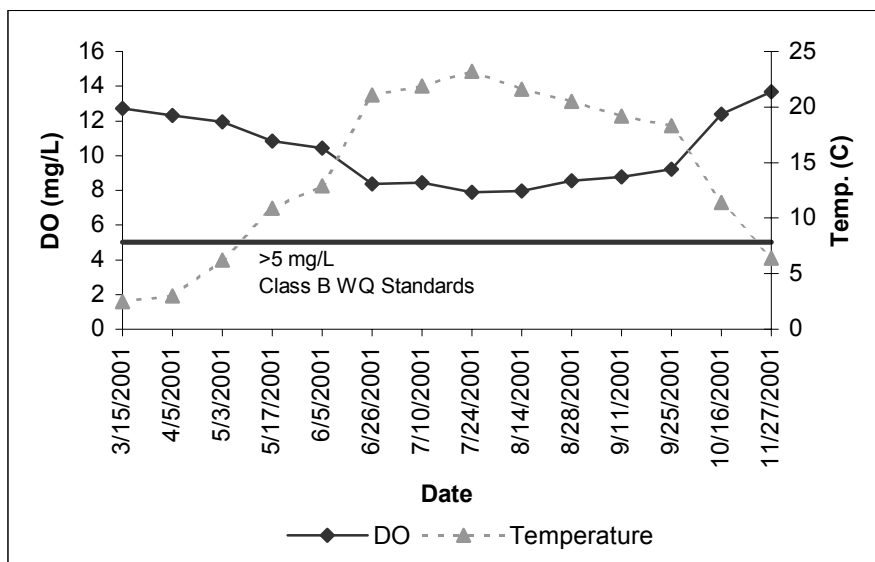


Figure 2. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 19-Sgr. Route 11 Bridge, Sunapee, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 5.74 to 7.62, was measured below the state standard on 11 of 14 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 3 shows the instantaneous *E. coli* counts during summer 2001.

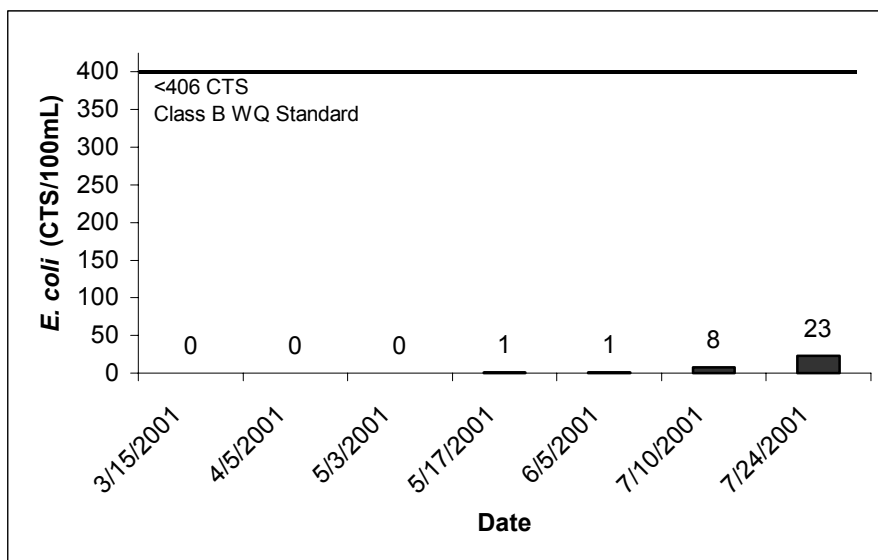


Figure 3. *E. coli* Bacteria Counts. Sugar River at 19-Sgr. Route 11 Bridge, Sunapee, NH. VRAP, Year 2001.

4.1.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli*: Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should continue to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river, and provide early detection of changes in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data

at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH*: If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.2. 16-Sgr: Route 103 Bridge, Sunapee, NH

4.2.1. Station Description

16-Sgr is located directly below a double culvert and discharge pipe at the intersection of two main roads (Figure 4). At this point the river has flowed from 19-Sgr through a forested and residential area and underneath an old railroad yard. The river is contained by culverts and has a boulder riverbed.

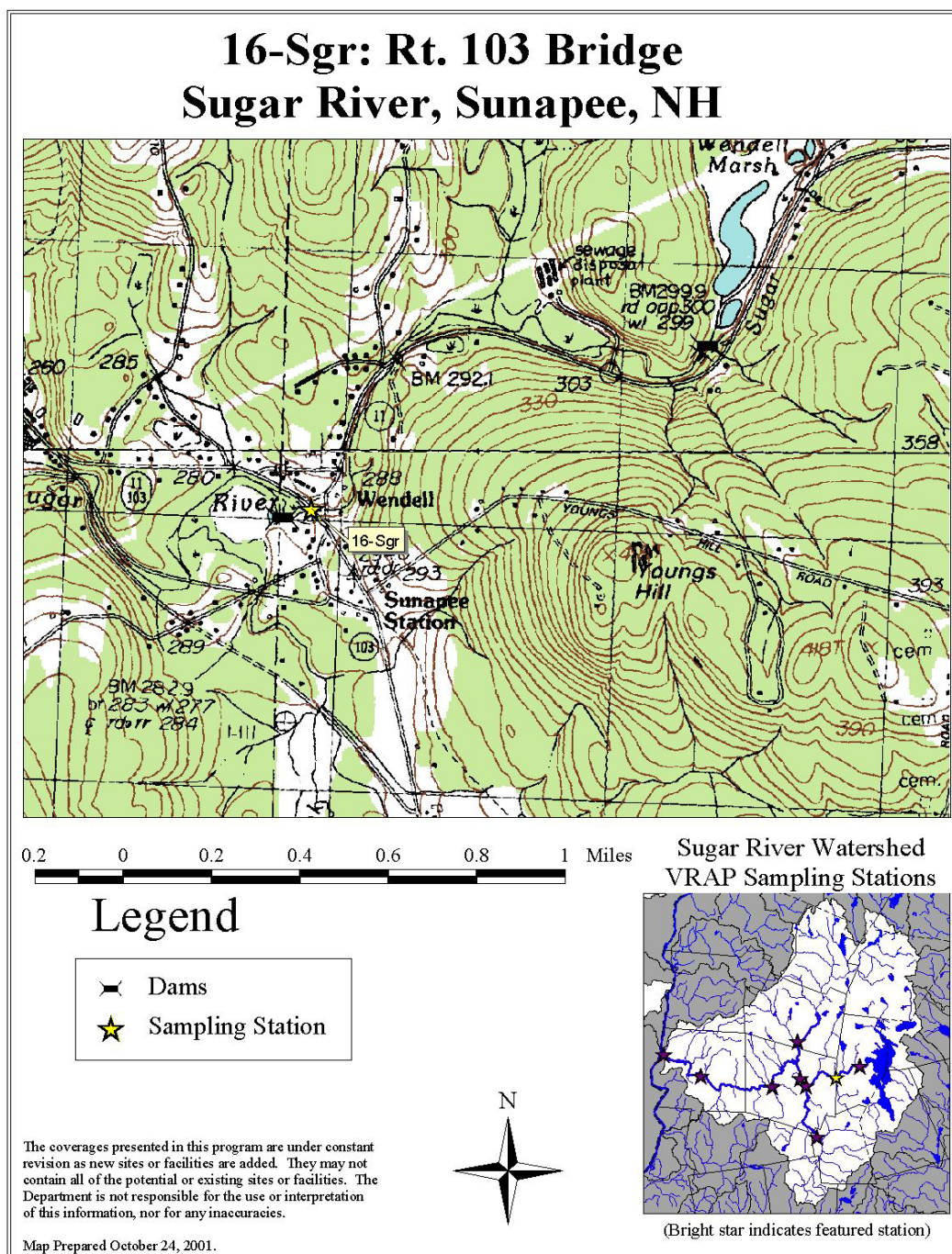


Figure 4. Station location map for 16-Sgr, Sugar River, New Hampshire, VRAP 2001.

4.2.2. Results and Discussion

Fourteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 12 measurements were made for conductivity in the field using handheld meters (Table 2). Eight samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Thirteen pH measurements were below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 2. Monitoring Summary: 16-Sgr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	7.66 - 14.27	>5
DO (% sat.)	14	14	0	83.8 - 118.7	>75
pH (Std. Units)	14	14	13	4.70 - 6.83	6.5-8.0
Turbidity (NTU)	14	14	0	0.04 - 1.88	<10 above background
Conductivity (µmho/cm)	12	12	0	61.1 - 114.5	NA
<i>E. coli</i> (CTS/100mL)	8	8	1	0 - 980	<406
Total Phosphorus (mg/L)	4	4	NA	<0.005 - 0.38	NA
NO ₃ mg/L	11	11	NA	<0.05 - 0.21	NA
Lead (mg/L)	1	1	0	<0.001	<0.014
Alkalinity (mg/L)	9	9	NA	5.3 - 19.2	NA
BOD ₅ (mg/L)	7	7	NA	5.01 - 8.75	NA
Arsenic (mg/L)	1	1	0	<0.001	<0.34
Mercury (mg/L)	1	1	0	<0.001	<0.0014

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 16-Sgr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 5). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

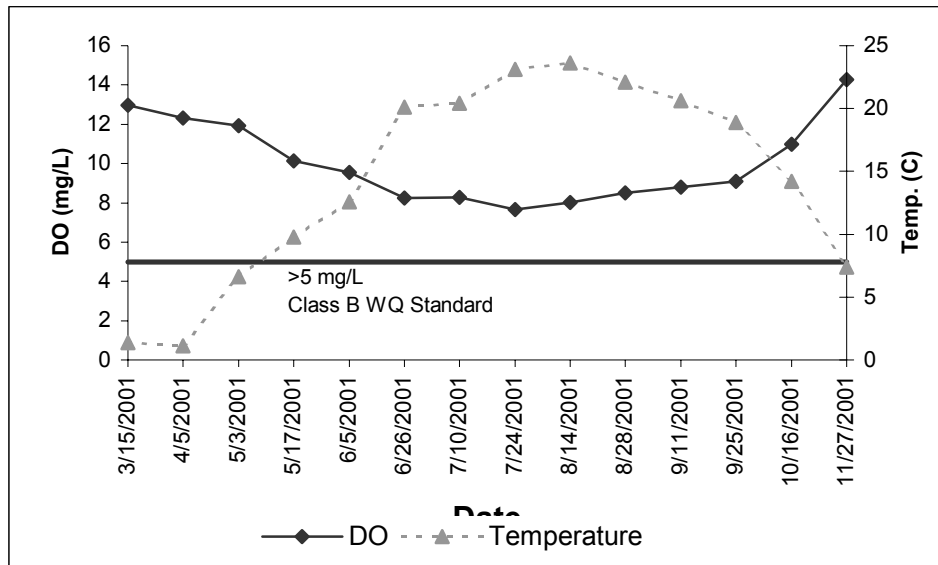


Figure 5. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 16-Sgr. Route 103 Bridge, Sunapee, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 4.70 to 6.83, was measured below the state standard on 13 of 14 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 6 shows the instantaneous *E. coli* counts during summer 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded twice. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

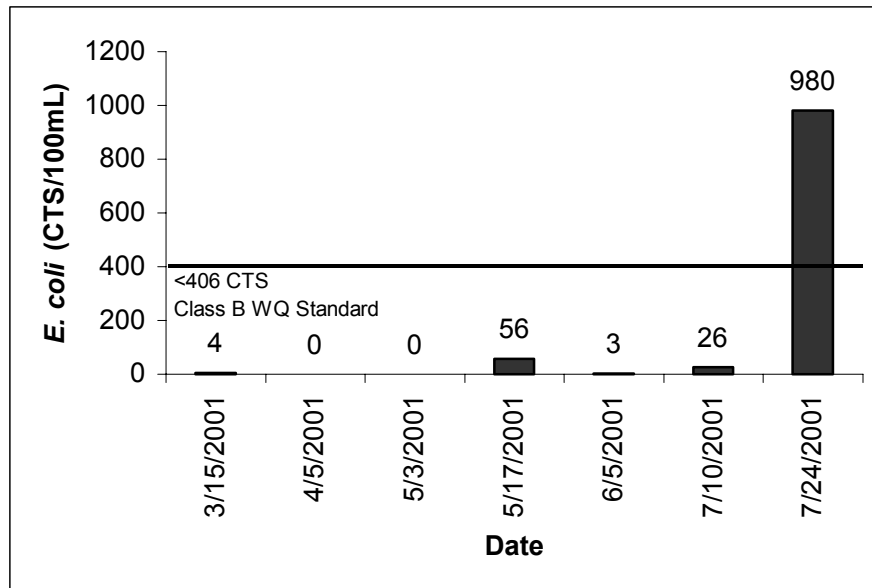


Figure 6. *E. coli* Bacteria Counts. Sugar River at 16-Sgr, Route 103 Bridge, Sunapee, NH. VRAP, Year 2001.

4.2.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are

encouraged to measure DO in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH*: If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.3. 12-Sgr: Route 10 Bridge, Newport, NH

4.3.1. Station Description

Located in downtown Newport, 12-Sgr is downstream of an impoundment, a suburban residential area, and old brick buildings (Figure 7). The silt and cobble riverbed is highly eroded on the right bank.

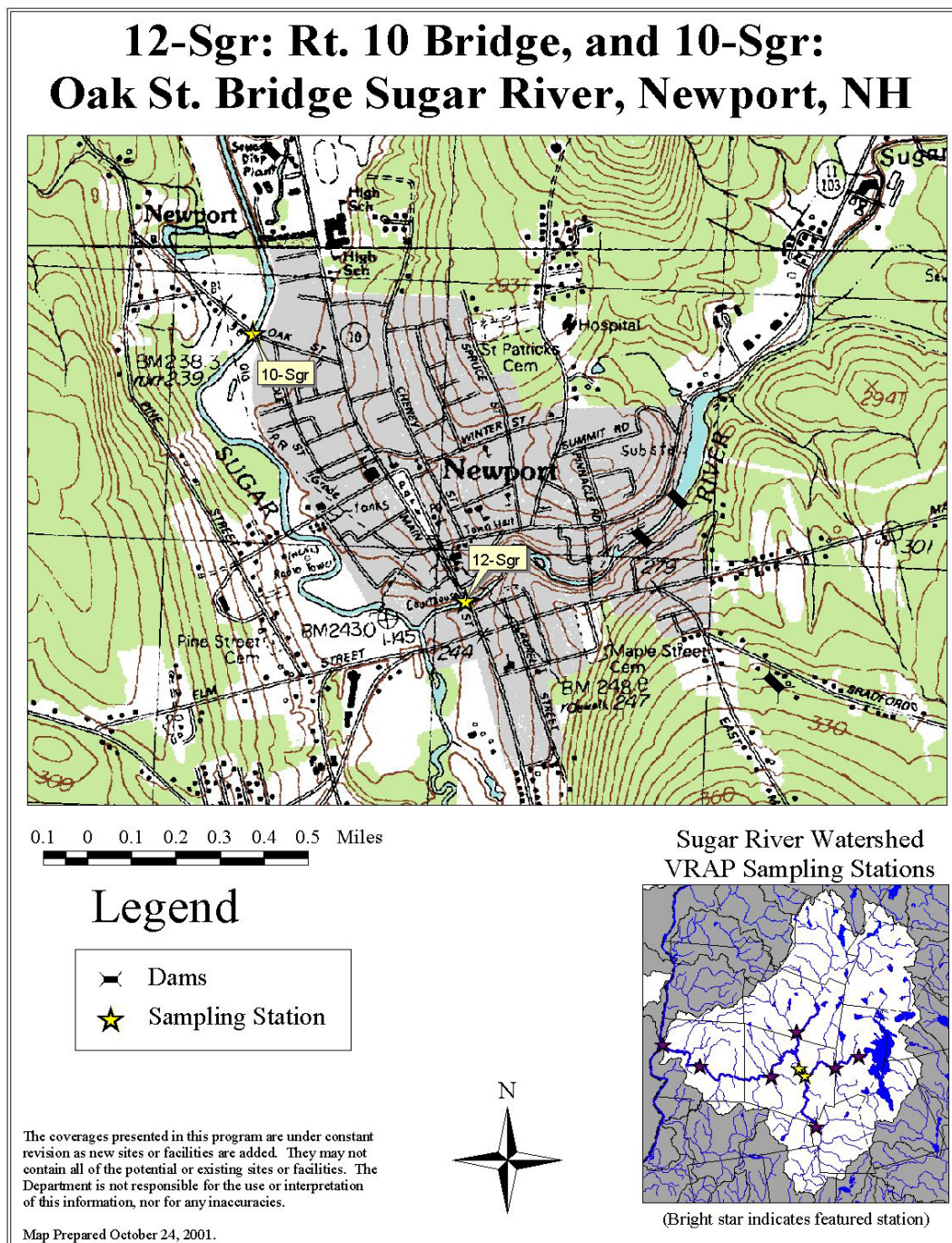


Figure 7. Station location map for 12-Sgr, Sugar River, New Hampshire, VRAP 2001.

4.3.2. Results and Discussion

Fourteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 13 measurements were made for conductivity in the field using handheld meters (Table 3). Seven samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Four pH measurements were below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 3. Monitoring Summary: 12-Sgr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	7.98 - 13.46	>5
DO (% sat.)	14	14	0	91 - 113.9	>75
pH (Std. Units)	14	14	4	5.35 - 7.49	6.5-8.0
Turbidity (NTU)	14	14	0	0.6 - 9.62	<10 above background
Conductivity (μmho/cm)	13	13	0	65.1 - 156.3	NA
<i>E. coli</i> (CTS/100mL)	7	7	1	0 - 1350	<406
Total Phosphorus (mg/L)	3	3	NA	0.005 - 0.27	NA
NO ₃ mg/L	11	11	NA	0.05 - 0.34	NA
Alkalinity (mg/L)	7	7	NA	8 - 23.2	NA
BOD ₅ (mg/L)	6	6	NA	5.26 - 8.16	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 12-Sgr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 8). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

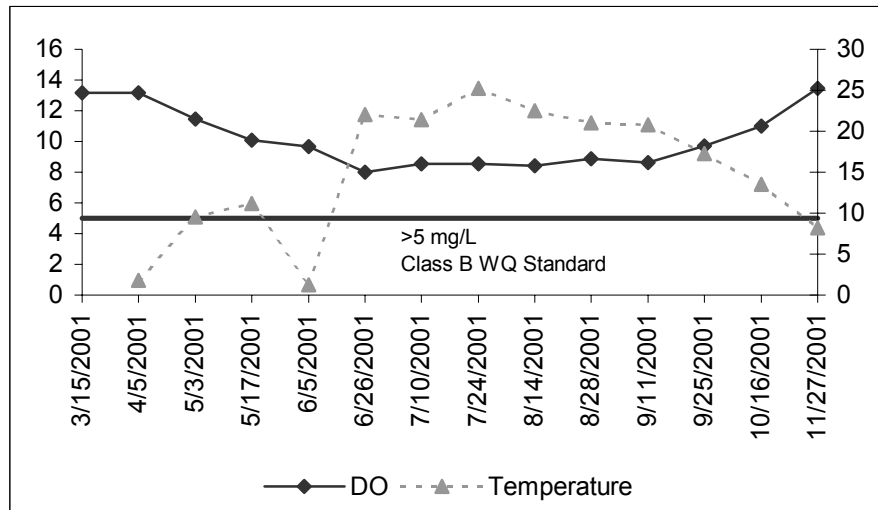


Figure 8. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 12-Sgr. Route 10 Bridge, Newport, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 5.35 to 7.49, was measured below the state standard on four of 14 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 9 shows the instantaneous *E. coli* counts during summer 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

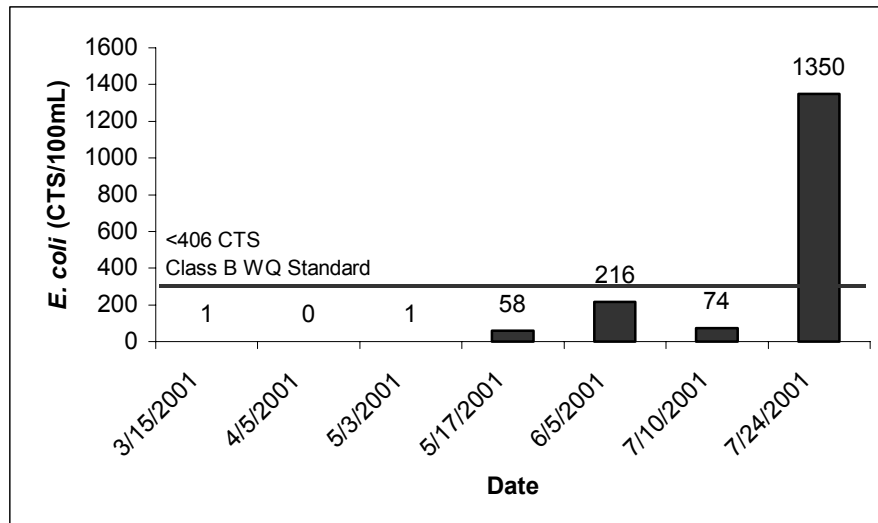


Figure 9. *E. coli* Bacteria Counts. Sugar River at 12-Sgr, Route 10 Bridge, Newport, NH. VRAP, Year 2001.

4.3.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO early in the morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe,

which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH*: If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.4. 04-Ssr: Lear Hill Road, Goshen, NH

4.4.1. Station Description

04-Ssr is part of the South Branch of the Sugar River, meeting just downstream of 12-Sgr. The station is located off of a main road in a heavily vegetated area (Figure 10). Houses are scattered upstream of the station and a bog is located upstream to the right. The river at this station is directly below a large rock dam and has a cobble riverbed.

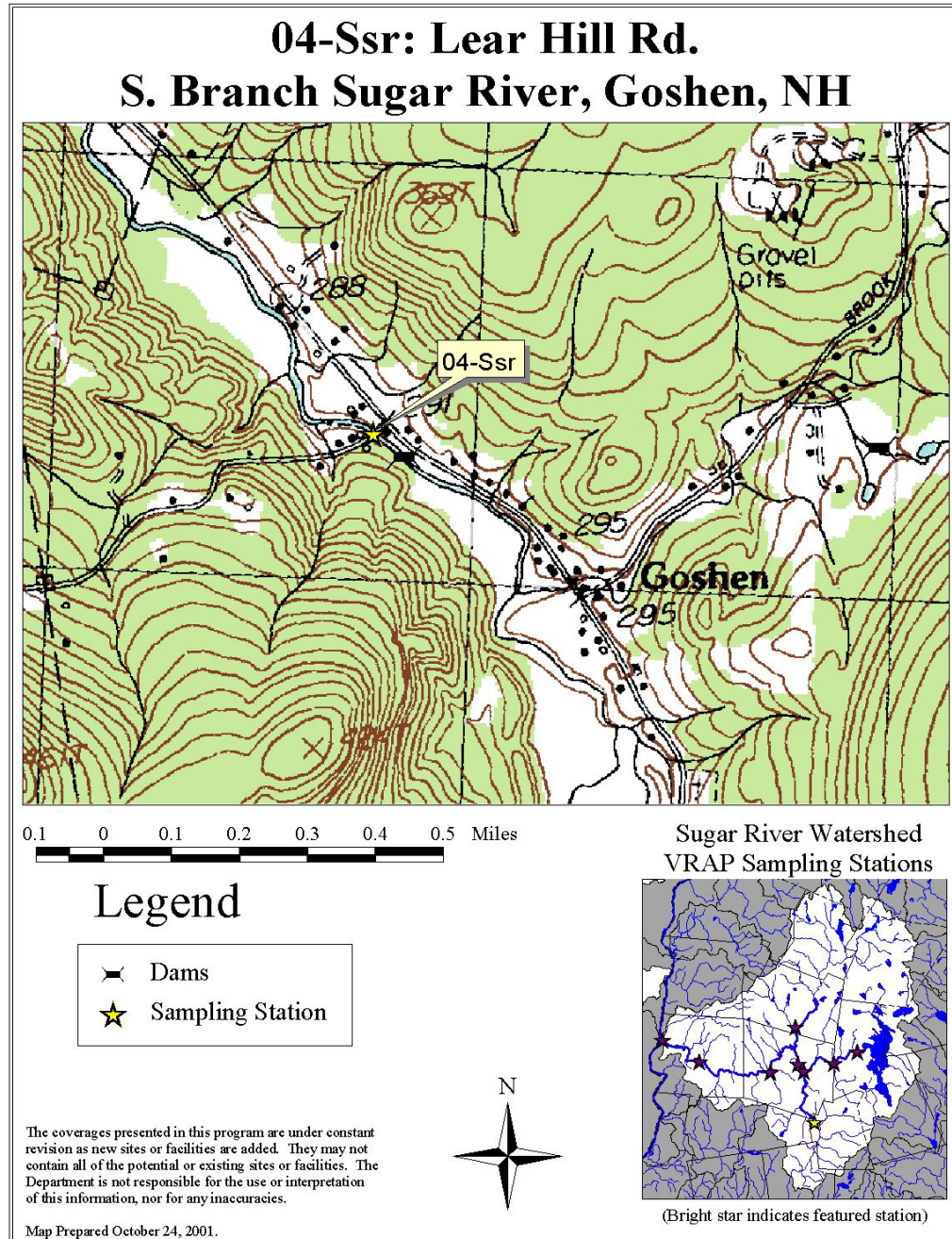


Figure 10. Station location map for 04-Ssr, Sugar River, New Hampshire, VRAP 2001.

4.4.2. Results and Discussion

Fourteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 11 measurements were made for conductivity in the field using handheld meters (Table 4). Nine samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Six pH measurements were below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 4. Monitoring Summary: 04-Ssr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	9.27 - 14.01	>5
DO (% sat.)	14	14	0	92.6 - 112.9	>75
pH (Std. Units)	14	14	6	5.73 - 7.42	6.5-8.0
Turbidity (NTU)	14	14	0	0.18 - 1.7	<10 above background
Conductivity (µmho/cm)	11	11	0	0 - 116.8	NA
<i>E. coli</i> (CTS/100mL)	9	9	1	1 - 700	<406
Total Phosphorus (mg/L)	4	4	NA	<0.005 - 0.23	NA
NO ₃ mg/L	11	11	NA	0.07 - 1.22	NA
Alkalinity (mg/L)	9	9	NA	4.0 - 23.6	NA
BOD ₅ (mg/L)	7	7	NA	6.4 - 8.51	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

** Metals standards represent fresh water acute criteria.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 04-Ssr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 11). However, the Class B New

Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

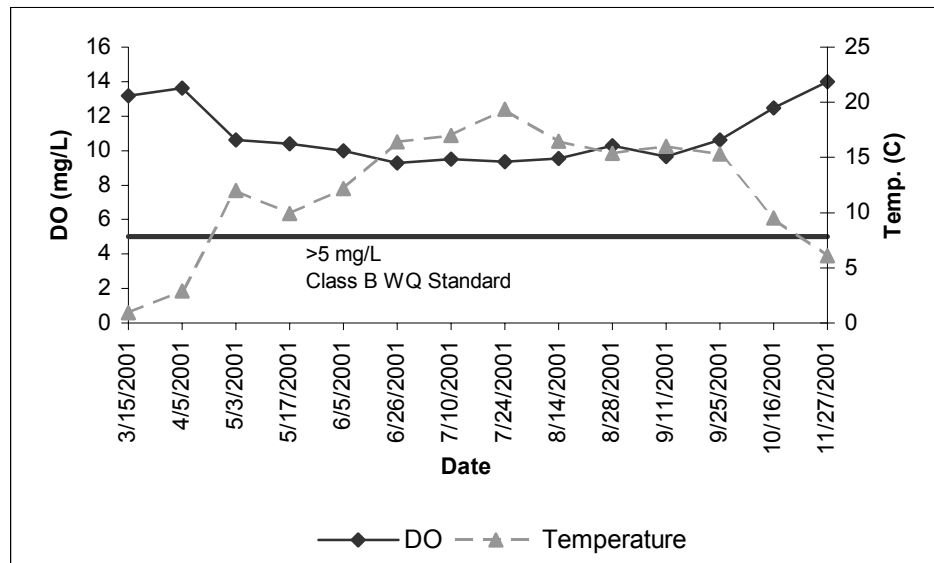


Figure 11. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 04-Ssr, Lear Hill Road, Goshen, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 5.73 to 7.42, was measured below the state standard on six of 14 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 12 shows the instantaneous *E. coli* counts during summer 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

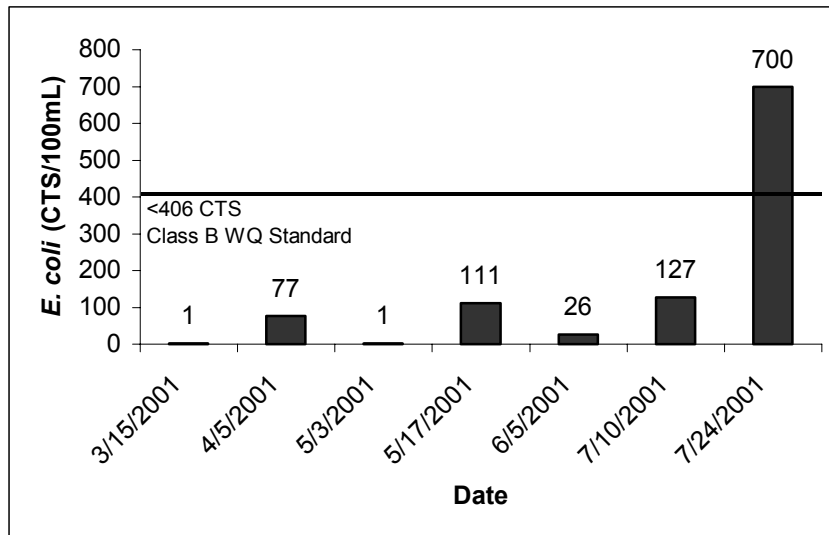


Figure 12. *E. coli* Bacteria Counts. Sugar River at 04-Ssr, Lear Hill Road, Goshen, NH. VRAP, Year 2001.

4.4.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO in the early morning and during the mid-afternoon

hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH*: If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.5. 10-Sgr: Oak Street Bridge, Newport, NH

4.5.1. Station Description

Downtown Newport is upstream of the station, giving way to the heavily wooded and residential area of 10-Sgr. See Figure 7 in Section 4.2. An old railroad bridge is still in use just upstream of the station. The riverbed is made of cobble and signs of erosion can be seen along the banks.

4.5.2. Results and Discussion

Fourteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 13 measurements were made for conductivity in the field using handheld meters (Table 5). Seven samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Six pH measurements were below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 5. Monitoring Summary: 10-Sgr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	8.21 - 13.67	>5
DO (% sat.)	14	14	0	90.2 - 113.3	>75
pH (Std. Units)	14	14	6	5.84 - 7.41	6.5-8.0
Turbidity (NTU)	14	14	0	0.87 - 2.5	<10 above background
Conductivity (µmho/cm)	13	13	0	0 - 189.7	NA
<i>E. coli</i> (CTS/100mL)	7	7	0	2 - 210	<406
Total Phosphorus (mg/L)	5	5	NA	0.008 - 0.35	NA
NO ₃ mg/L	11	11	NA	0.07 - 0.98	NA
Alkalinity (mg/L)	8	8	NA	2.8 - 21.6	NA
BOD ₅ (mg/L)	7	7	NA	6.09 - 8.34	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 10-Sgr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 13). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

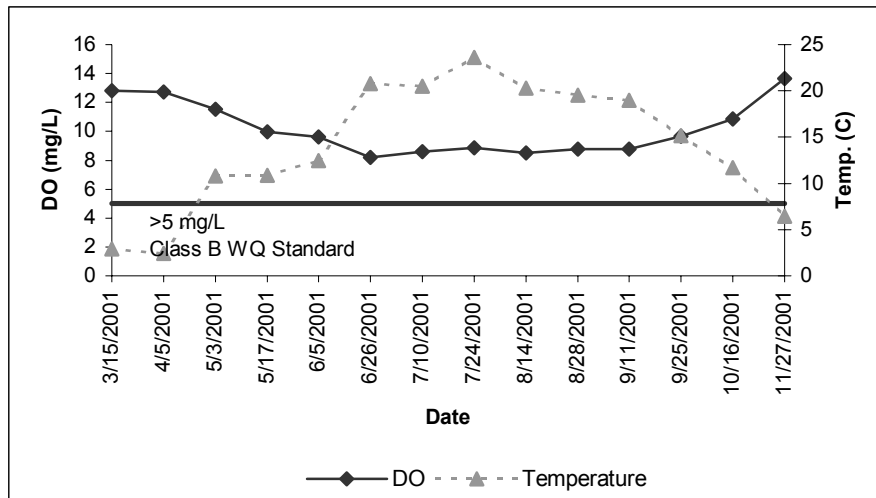


Figure 13. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 10-Sgr, Oak Street Bridge, Newport, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 5.84 to 7.41, was measured below the state standard on six of 14 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 14 shows the instantaneous *E. coli* counts during summer 2001.

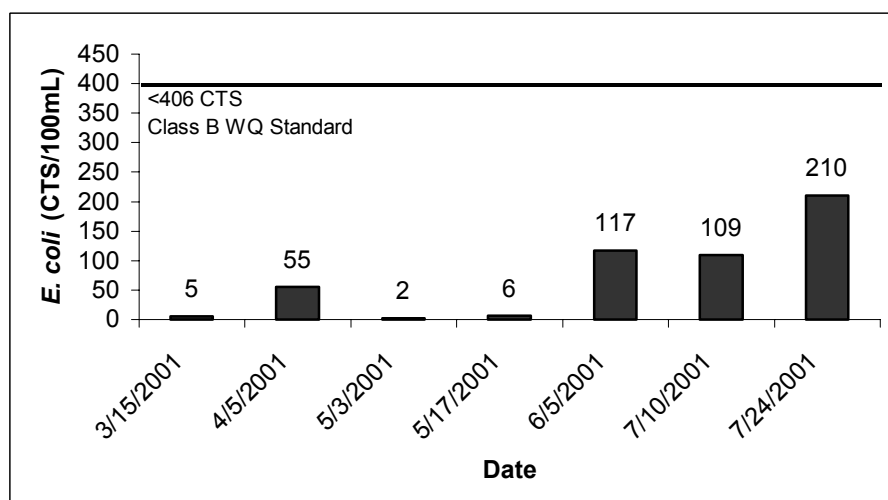


Figure 14. *E. coli* Bacteria Counts. Sugar River at 10-Sgr, Oak Street Bridge, Newport, NH. VRAP, Year 2001.

4.5.3. Recommendations

- *Baseline Monitoring:* Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli:* Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).
- *Dissolved Oxygen:* Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.
- *pH:* If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.6. 02-Nsr: Route 10 Bridge, Croyden, NH

4.6.1. Station Description

The North Branch joins the Sugar River downstream of 10-Sgr (Figure 15). Upstream of 02-Nsr lies an inaccessible bridge and a large wooded area. An old drainage pipe lies upstream of the station. The river appears heavily eroded and the riverbed is strewn with boulders.

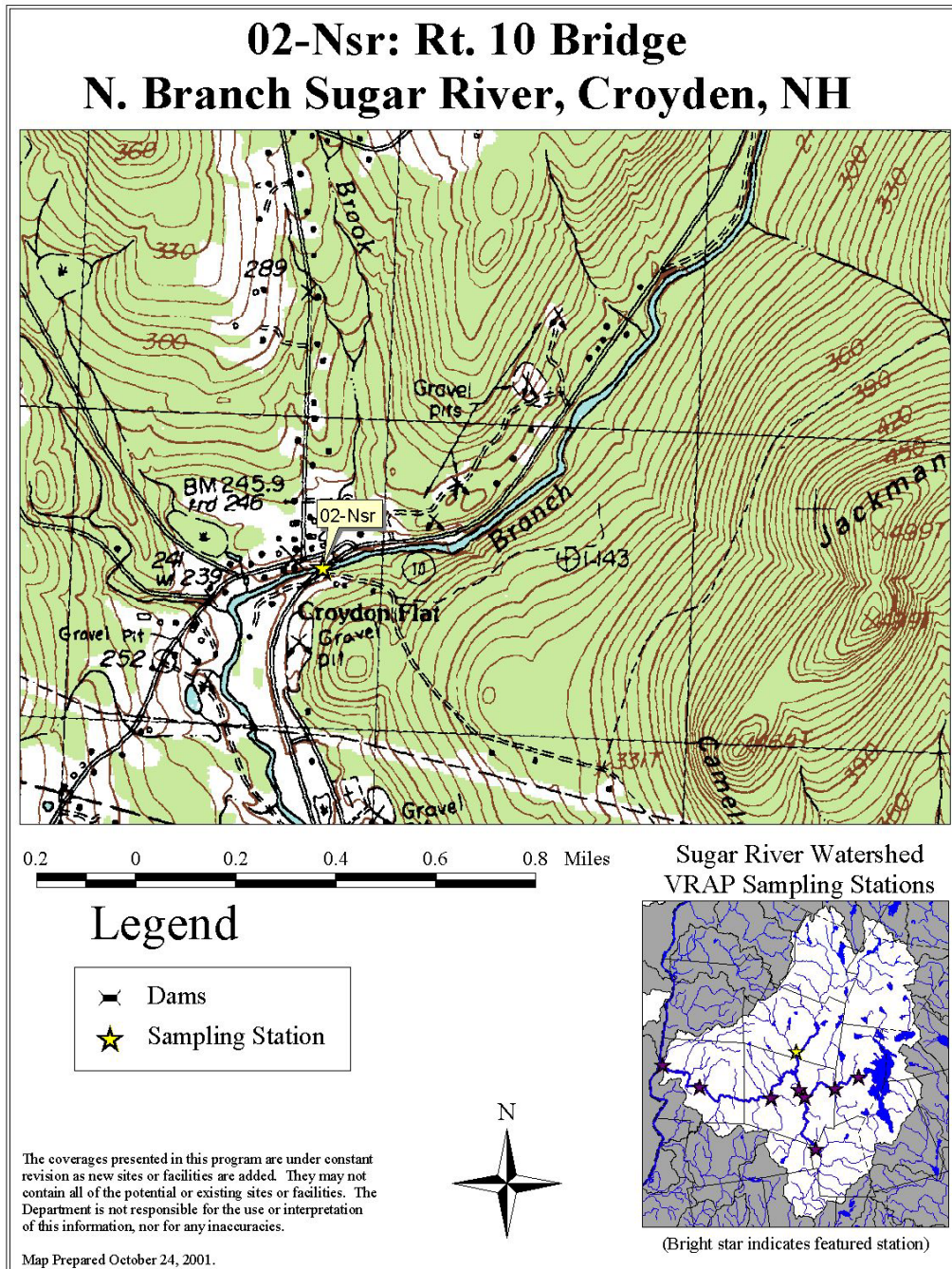


Figure 15. Station location map for 02-Nsr, North Branch Sugar River, New Hampshire, VRAP 2001.

4.6.2. Results and Discussion

Fourteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 13 measurements were made for conductivity in the field using handheld meters (Table 6). Seven samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Ten pH measurements were below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 6. Monitoring Summary: 02-Nsr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	8.18 - 14.64	>5
DO (% sat.)	14	14	0	89.3 - 113.8	>75
pH (Std. Units)	14	14	10	5.37 - 7.08	6.5-8.0
Turbidity (NTU)	14	14	0	0.45 - 1.74	<10 above background
Conductivity (µmho/cm)	13	13	0	72 - 189.9	NA
<i>E. coli</i> (CTS/100mL)	7	7	1	0 - 1104	<406
Total Phosphorus (mg/L)	4	4	NA	<0.005 - 0.24	NA
NO ₃ mg/L	11	11	NA	<0.05 - 0.16	NA
Lead (mg/L)	1	1	0	<0.001	<0.014
Alkalinity (mg/L)	8	8	NA	6.0 - 23.2	NA
BOD ₅ (mg/L)	7	7	NA	5.0 - 8.65	NA
Arsenic (mg/L)	1	1	0	<0.001	<0.34
Mercury (mg/L)	1	1	0	<0.001	<0.0014

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 02-Nsr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 16). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

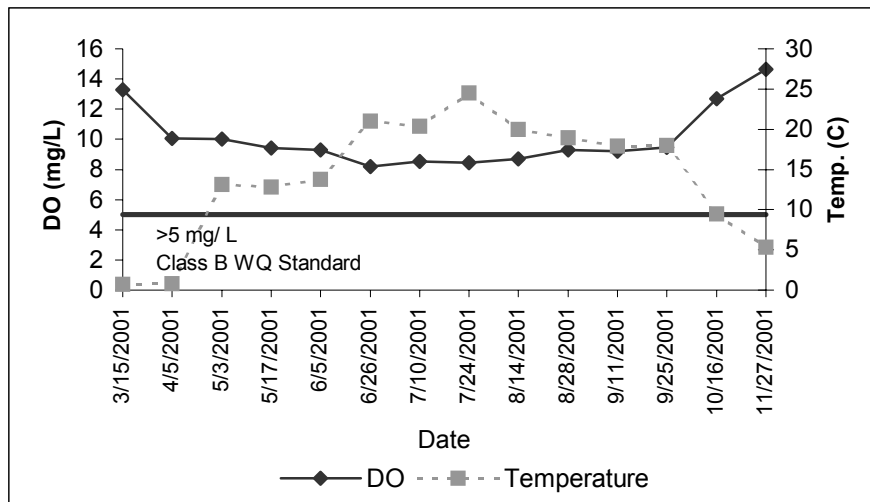


Figure 16. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 02-Nsr, Route 10 Bridge, Croyden, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 5.37 to 7.08, was measured below the state standard on 10 of 14 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 17 shows the instantaneous *E. coli* counts during summer 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

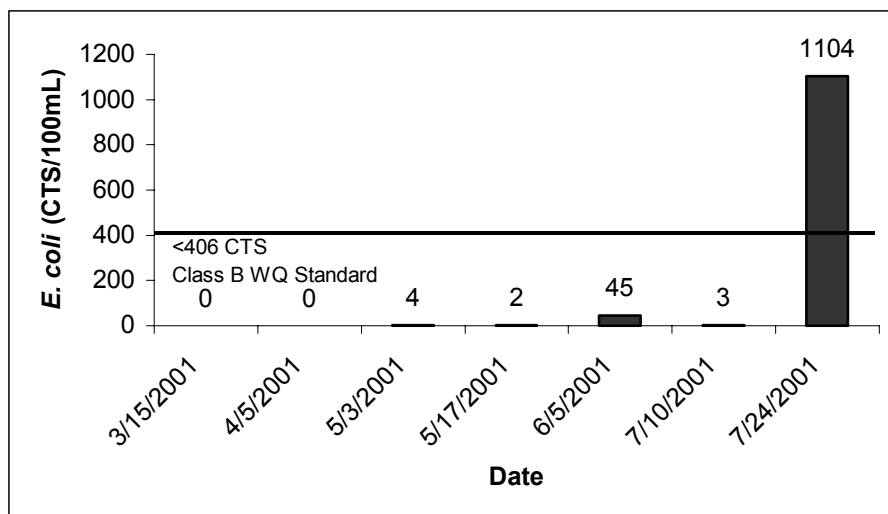


Figure 17. *E. coli* Bacteria Counts. Sugar River at 02-Nsr, Route 10 Bridge, Croyden, NH. VRAP, Year 2001.

4.6.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe,

which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH*: If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.7. 07-Sgr: Kellyville Bridge, Newport, NH

4.7.1. Station Description

07-Sgr is located along a main road in a fairly unpopulated area (Figure 18). Just upstream of the station is a “log yard” followed by five miles of woodland. The river shows little sign of erosion and has a cobble riverbed.

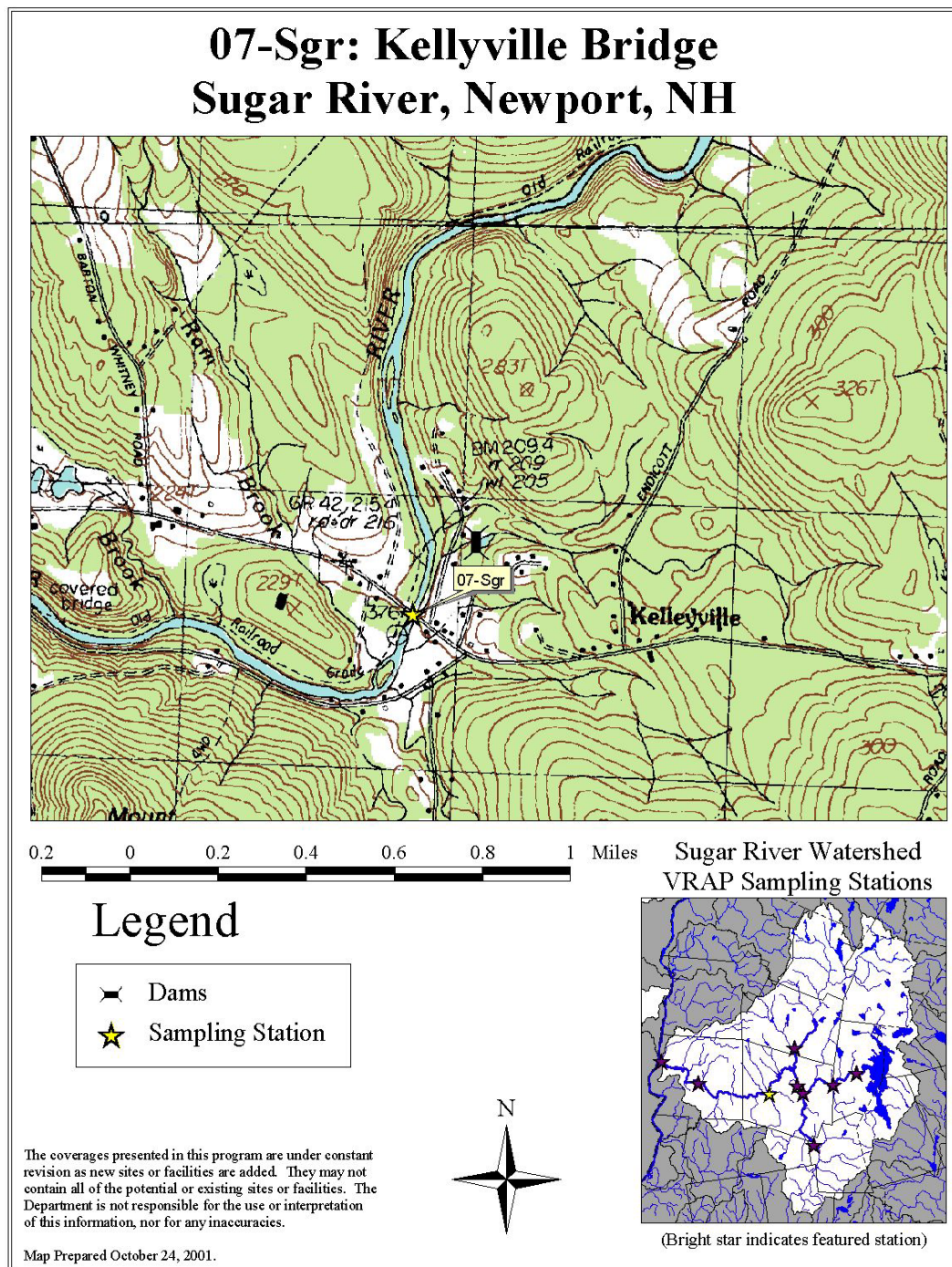


Figure 18. Station location map for 07-Sgr, Sugar River, New Hampshire, VRAP 2001.

4.7.2. Results and Discussion

Thirteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 11 measurements were made for conductivity in the field using handheld meters (Table 7). Six samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Two pH measurements were below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 7. Monitoring Summary: 07-Sgr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	8.48 - 14.59	>5
DO (% sat.)	13	13	0	95.2 - 119.6	>75
pH (Std. Units)	13	13	2	5.25 - 7.51	6.5-8.0
Turbidity (NTU)	13	13	0	0.7 - 1.46	<10 above background
Conductivity (µmho/cm)	11	11	0	77 - 181.4	NA
<i>E. coli</i> (CTS/100mL)	6	6	0	0 - 280	<406
Total Phosphorus (mg/L)	9	9	NA	0.005 - 0.065	NA
NO ₃ mg/L	12	12	NA	<0.05 - 8.29	NA
Lead (mg/L)	6	6	0	<0.001 - 0.0125	<0.014
Alkalinity (mg/L)	14	14	NA	4.4 - 28.4	NA
BOD ₅ (mg/L)	6	6	NA	6.04 - 8.37	NA
Arsenic (mg/L)	6	6	0	<0.001 - 0.001	<0.34
Mercury (mg/L)	3	3	0	<0.001	<0.0014

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 07-Sgr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 19). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

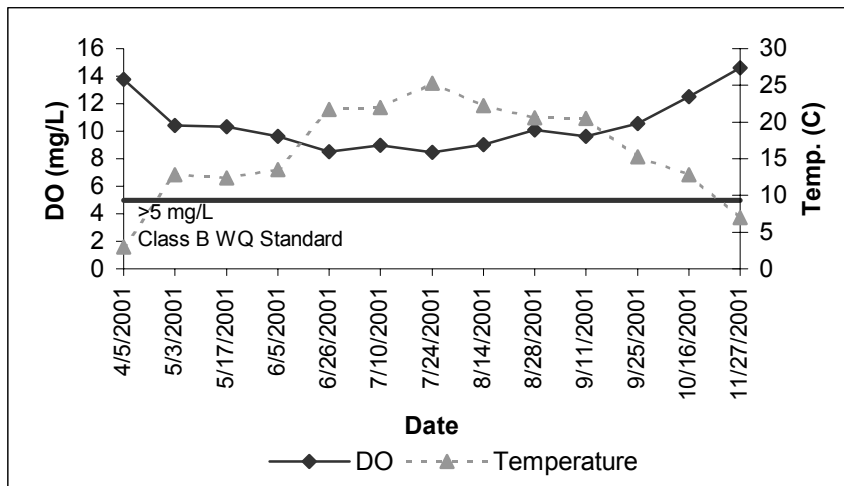


Figure 19. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 07-Sgr, Kellyville Bridge, Newport, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 5.25 to 7.51, was measured below the state standard on two of 13 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 20 shows the instantaneous *E. coli* counts during summer 2001.

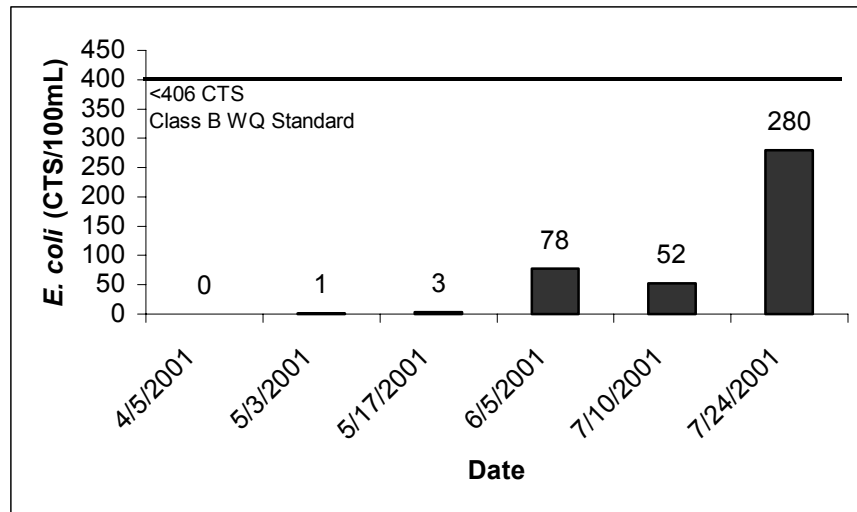


Figure 20. *E. coli* Bacteria Counts. Sugar River at 07-Sgr, Kellyville Bridge, Newport, NH. VRAP, Year 2001.

4.7.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO in the early morning and during the mid-afternoon

hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH*: If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.8. 05-Sgr: Puksta Bridge, Claremont, NH

4.8.1. Station Description

05-Sgr is directly below a dam in the heart of downtown Claremont (Figure 21). A drainage pipe into the river provides run-off for the surrounding parking lots and busy main roads. There is some dense vegetation along the banks and further upstream is a densely populated suburban area and gas stations. The riverbed at this station is bedrock.

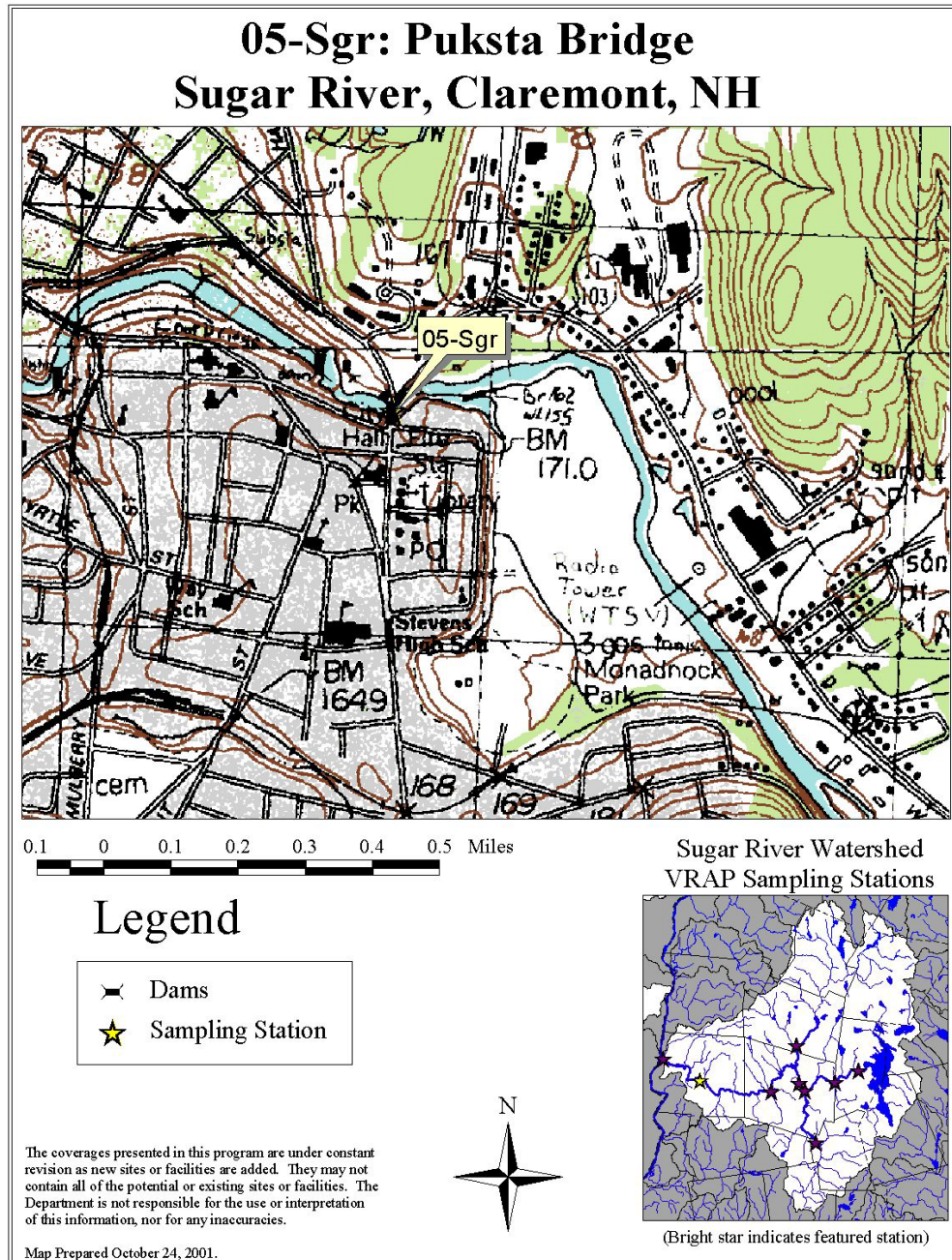


Figure 21. Station location map for 05-Sgr, Sugar River, New Hampshire, VRAP 2001.

4.8.2. Results and Discussion

Fourteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 13 measurements were made for conductivity in the field using handheld meters (Table 8). Eight samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. One pH measurement was below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 8. Monitoring Summary: 05-Sgr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	8.41 - 14.02	>5
DO (% sat.)	14	14	0	82.8 - 115.6	>75
pH (Std. Units)	14	14	1	6.18 - 7.7	6.5-8.0
Turbidity (NTU)	14	14	0	0.59 - 1.7	<10 above background
Conductivity (µmho/cm)	13	13	0	37 - 176.9	NA
<i>E. coli</i> (CTS/100mL)	8	8	0	0 - 200	<406
Total Phosphorus (mg/L)	13	13	NA	0.008 - 0.3	NA
NO ₃ mg/L	11	11	NA	<0.05 - 0.19	NA
Lead (mg/L)	7	7	0	<0.001 - 0.0027	<0.014
Alkalinity (mg/L)	16	16	NA	6.8 - 33.2	NA
BOD ₅ (mg/L)	6	6	NA	5.2 - 8.34	NA
Arsenic (mg/L)	7	7	0	<0.001	<0.34
Mercury (mg/L)	3	3	0	<0.001	<0.0014

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 05-Sgr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 22). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

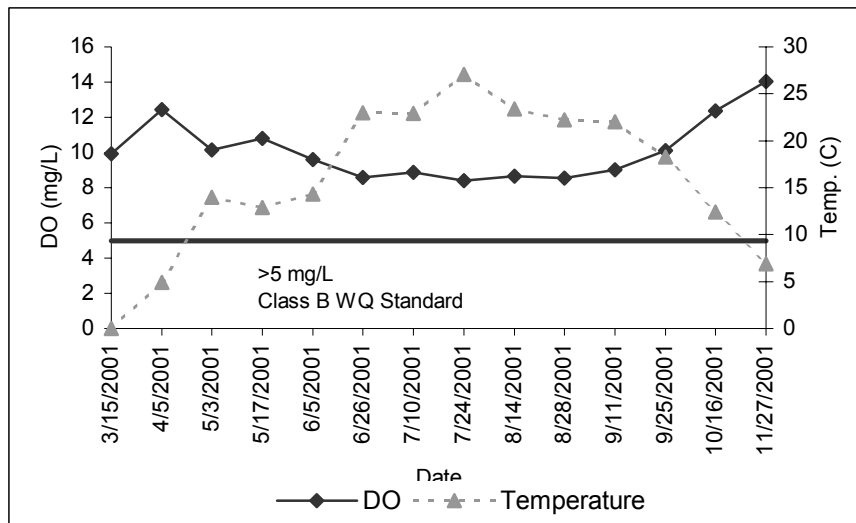


Figure 22. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 05-Sgr, Puksta Bridge, Claremont, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 6.18 to 7.70, was measured below the state standard on one of 14 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 23 shows the instantaneous *E. coli* counts during summer 2001.

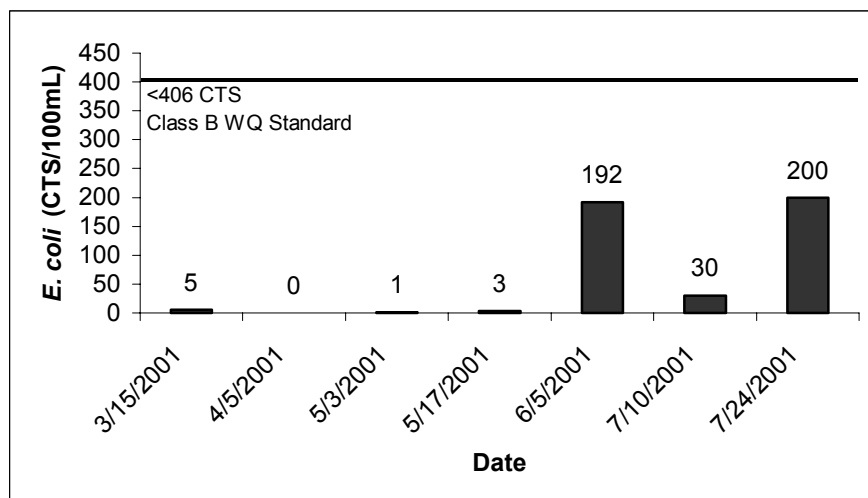


Figure 23. *E. coli* Bacteria Counts. Sugar River at 05-Sgr, Puksta Bridge, Claremont, NH. VRAP, Year 2001.

4.8.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- ***E. coli*:** Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).
- **Dissolved Oxygen:** Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every

1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH*: If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

4.9. 01-Sgr: Lottery Bridge, Claremont, NH

4.9.1. Station Description

01-Sgr is located downstream from downtown Claremont (Figure 24). Upstream of the station are major roads, fields, a paper mill and a wastewater treatment facility. There is dense vegetation along the riverbanks only and the riverbed is a mix of silt and cobble.

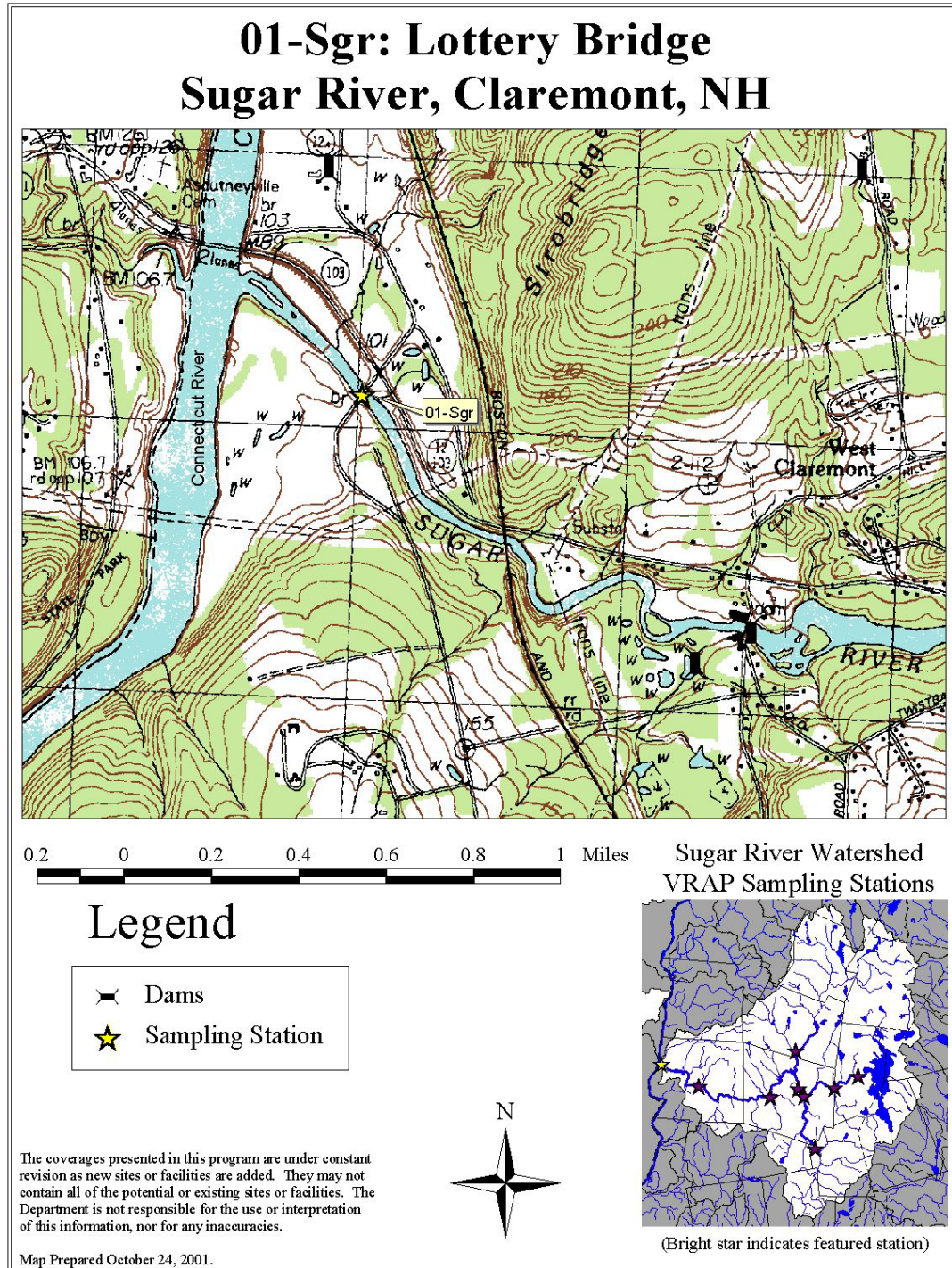


Figure 24. Station location map for 01-Sgr, Sugar River, New Hampshire, VRAP 2001.

4.9.2. Results and Discussion

Fourteen measurements were made for dissolved oxygen (DO), pH, and turbidity, and 13 measurements were made for conductivity in the field using handheld meters (Table 9). Ten samples were collected for *E. coli* bacteria, and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. One pH measurement was below the Class B Water Quality Standard. The DO concentration data do not show any apparent DO problems. However, it should be noted that these data do not completely characterize DO relative to the surface water quality standards (see explanation under Dissolved Oxygen, below).

Table 9. Monitoring Summary: 01-Sgr. VRAP, Year 2001.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	14	14	0	8.15 - 15.01	>5
DO (% sat.)	14	14	0	93.3 - 122.7	>75
pH (Std. Units)	14	14	1	6.44 - 7.44	6.5-8.0
Turbidity (NTU)	14	14	0	0.85 - 3.4	<10 above background
Conductivity (µmho/cm)	13	13	0	78.1 - 226.3	NA
<i>E. coli</i> (CTS/100mL)	10	10	1	1 - 980	<406
Total Phosphorus (mg/L)	13	13	NA	0.013 - 0.514	NA
NO ₃ mg/L	14	14	NA	0.1 - 0.56	NA
Lead (mg/L)	8	8	0	<0.001 - 0.0026	<0.014
Alkalinity (mg/L)	16	16	NA	6.4 - 108	NA
BOD ₅ (mg/L)	7	7	NA	5.7 - 8.39	NA
Arsenic (mg/L)	8	8	0	<0.001	<0.34
Mercury (mg/L)	4	4	0	<0.001	<0.0014

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Dissolved oxygen concentrations in the river at 01-Sgr were greater than the minimum instantaneous concentration of 5 mg/L (see Figure 25). However, the Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum daily average saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Thus, additional sampling is necessary.

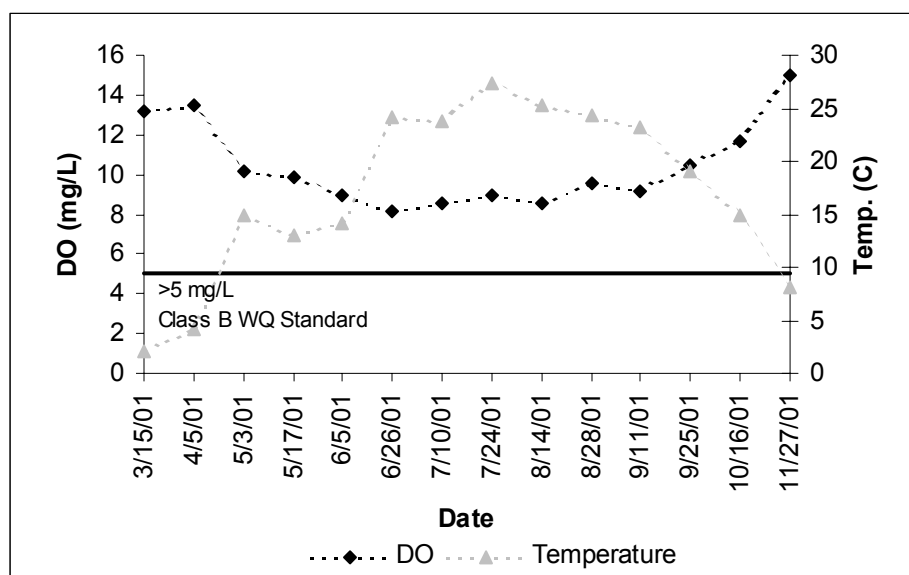


Figure 25. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 01-Sgr, Lottery Bridge, Claremont, NH. VRAP, Year 2001.

pH

The pH at this location, ranging from 6.44 to 7.44, was measured below the state standard on one of 14 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. If the sampling location is influenced by natural conditions, low pH measurements are not considered a violation of surface water quality standards. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. The pH of surface waters can be affected by soil, subsurface bedrock, and wetlands near the river or stream. In addition, rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels. Additional sampling is needed at this station.

E. coli

Figure 26 shows the instantaneous *E. coli* counts during summer 2001. The Class B surface water quality standard for instantaneous bacteria counts was exceeded once. Additional sampling is necessary to determine the extent and magnitude of the potential problem.

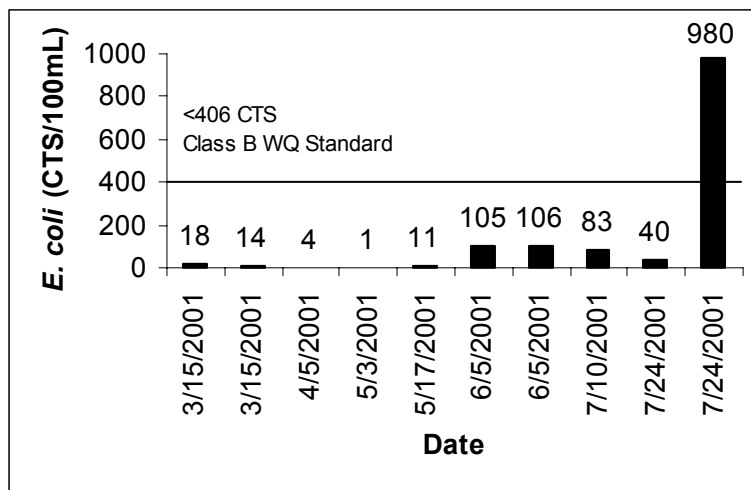


Figure 26. *E. coli* Bacteria Counts. Sugar River at 01-Sgr, Lottery Bridge, Claremont, NH. VRAP, Year 2001.

4.9.3. Recommendations

- *Baseline Monitoring:* Volunteers are encouraged to continue sampling for all parameters, especially DO and pH, at this station. More information in the baseline data set will allow for a better understanding of the variations that the river encounters during the year. In addition, this will allow for better documentation of water quality, as related to New Hampshire surface water quality standards.

For an increased understanding of water quality conditions at the time of sampling, volunteers should remember to be specific about the weather conditions and other characteristics of the sampling station.

- *E. coli:* Continued *E. coli* sampling at this station is encouraged, as *E. coli* can influence the recreational use of the river. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. Volunteers should strive to collect at least three samples during a 60-day period, which allows the NHDES to determine the geometric mean of *E. coli*. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water. In addition, the areas that exceeded the water quality standard should be investigated in more detail. For example, samples could be collected at smaller intervals (i.e., upstream and downstream).
- *Dissolved Oxygen:* Measurements should continually be made at this station on a routine basis. This will help document variations in the river. As previously stated, there are criteria for both concentration **and** saturation that must be met before the river can be considered as meeting DO standards. Volunteers are encouraged to measure DO in the early morning and during the mid-afternoon hours. This could be done by using a Hydrolab® DataSonde 4a multiprobe,

which is an instrument that can collect data at specific time intervals (e.g., every 1-hour). The instrument can be put in the stream and left alone for a period of several days. The use of this instrument is dependent upon availability, and requires coordination with DES.

- *pH*: If wetland drainage is present, sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

Appendix A:
List of Stations

Appendix B:
Raw Data Tables

Appendix C:

Water Quality Parameters and Surface Water Quality Standards

Appendix D:
River Graphs

Appendix E:
Field Sampling Protocols